

REMARKS

Further consideration of this application courteously is solicited. Claims 1-7 remain pending, with independent claims 1, 5, and 6 amended further hereby. All claims are active.

Initially, the grant of the interview by Examiners Joseph Perrin and Joy Watson on March 10, 2008 was appreciated. It is believed that the discussions during the interview will substantially expedite the prosecution of this application. A Declaration under 37 C.F.R. § 1.132 is submitted herewith as a result of the interview. Independent claims 1, 5, and 6 all have been amended in the way resulting from discussions during the interview.

As amended, each of claims 1, 5, and 6 clarifies that the heat treatment apparatus, cleaned according to Applicants' methods, includes a treatment vessel that has quartz structures that are exposed to film growth during a TEOS process. That is, the SiO₂ (claim 1), AsSG (claim 5), or BSG (claim 6) film also becomes deposited upon the quartz structures within the vessels. Each claim then goes on to expressly to limit the cleaning time, with a mixed gas of HF and NH₃, to a period of 0.6 minutes or less. This duration of the cleaning period is critical in protecting the quartz structures from damage by exposure to the mixed HF and NH₃ gases.

The JP1-286424 disclosure (hereinafter the '424 disclosure) and the Ye et al. patent (namely the 5,817,534 patent, and hereinafter referred to as the '534 patent) were discussed at length during the interview. It is recognized that the '424 disclosure teaches introducing aqueous or vaporized HF and aqueous or vaporized NH₃ into a reaction chamber to clean the chamber. The '424 disclosure emphasizes that its process can reduce cleaning time, previously requiring more than one hour, to approximately 5 minutes. The disclosure characterizes this as a drastic reduction in cleaning time with a corresponding increase in efficiency. As to '534 patent, it is recognized that this patent refers to benefits in employing fluorine chemistry to speed up cleaning processes. It also, however, points out disadvantages in using fluorine chemistry during cleaning, such as where fluorine in plasma during cleaning produces "hard-to-remove aluminum

fluoride contaminants” if aluminum resides in the chamber when the cleaning operation begins. (Column 5, lines 7-16.)

Applicants’ methods of independent claims 1, 5, and 6 represent another patentable improvement in reducing cleaning time for heat treatment apparatus. Specifically, Applicants have reduced the cleaning time from the approximately 5 minutes accomplished by the ‘424 disclosure to 0.6 minutes (or less). The duration of cleaning time is critical, and Applicants’ reduction to 0.6 minutes or less is a patentable improvement over the ‘424 disclosure, whether such disclosure is considered with, or without, the ‘534 patent. Cleaning duration is critical because mixed HF and NH₃ gases that clean the treatment vessel and its quartz structures of SiO₂, AsSG, or BSG film also attack the quartz structures. This unfortunate fact is discussed in Applicants’ specification, and reiterated in the attached Declaration by coinventor, Mr. Kazuhide Hasebe. As Mr. Hasebe’s Declaration explains, mixtures of HF and NH₃ gases can damage quartz exposed to such gases. The Declaration purposely introduces the cost of a quartz treatment vessel into evidence. A vessel such as treatment vessel 8 shown in Figs. 1, 3, and 4 of the Applicants’ disclosure costs on the order of \$50,000. Obviously, to avoid large replacement expenses, it is critical to minimize the time of exposure of the quartz components to the mixed HF and NH₃ gases to prolong their useful life. As the Declaration also points out, wafer boats, such as boat 10 in Applicants’ Figs. 1, 3, and 4, likewise are very expensive. Applicants’ methods minimize damage to very expensive quartz components by vastly reducing the time of exposure of such mixed gas to such components. This is critical in avoiding large component replacement costs.

To fully appreciate Applicants’ endeavor, attention is invited to the first full paragraph on page 12 of their specification. Applicants’ experience has been that frequently, there are errors in calculating the exact time period required for treatment vessel cleaning. Overestimates of the time necessary for cleaning commonly are made. Applicants’ paragraph at page 12 gives a 10% error as an example of extra or “excessive” cleaning done after all desired films already have been removed. In the conventional method discussed by Applicants’ specification, the calculated

cleaning period was 60 minutes, and thus an additional or “excessive” cleaning time of 10% is added. This translates to carrying out cleaning for an additional six minutes. This means, of course, that the expensive quartz components would be exposed to the damaging mixed gas for six minutes longer than necessary. Applicants’ cleaning methods, however, reduce such “excessive” exposure time to the mixed gases to only 10% of 0.06 minutes, or 3.6 seconds. Applying this example to the ‘424 disclosure, one sees that a 10% excessive cleaning time means that the ‘424 disclosure method would expose the delicate quartz components to the mixed gases for a full 30 seconds. Over repeated cleanings, this can become highly destructive to the quartz. Again, Applicants’ claimed methods severely limit the time of exposure of the quartz to the gases.

For at least these reasons, Applicants courteously urge that the rejection of claims 1, 5, and 6 over the ‘424 disclosure and the ‘534 patent, as set out in the Office Action of November 29, 2007, is overcome. Applicants have established criticality for their vast reduction in the cleaning time. Hence, Applicants courteously request that the rejection be withdrawn.

The November 29, 2007 Action made separate rejections to dependent claims 3, 4, and 7. These rejections likewise are traversed. Neither of JP08-195381 nor U.S. Patent No. 6,880,561 remedies the deficiencies of the ‘424 disclosure and the ‘534 patent as discussed above in connection with independent claims 1, 5, and 6. Hence, the separate rejections of claim 3, and claims 4 and 7, likewise are overcome. Withdrawal of these rejections also respectfully is solicited.

In view of the foregoing amendments and remarks, it courteously is urged that all of the claims are allowable, and that this application is in condition for allowance. Favorable action in this regard earnestly is solicited.

If any other fees under 37 C.F.R. §§1.16 or 1.17 are due in connection with this filing, please charge the fees to Deposit Account No. 02-4300; Attorney Docket No. 033082 M 286. If an extension of time under 37 C.F.R. § 1.136 is necessary that is not accounted for in the papers

filed herewith, such an extension is requested. The extension fee should be charged to Deposit Account No. 02-4300; Attorney Docket No. 033082 M 286.

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